DOCUMENT RESUME

ED 148 033 EC 103 058

AUTHOR McCormack, James E.
TITLE Teaching Pre-Academic Skills to Severely Handicapped Students.
INSTITUTION Seaside Education Associates, Gloucester, Mass.
PUB DATE 77
NOTE 46p.; For further information contact Special Projects, Massachusetts Department of Education, 31 St. James Avenue, Boston, Massachusetts ; For related documents, see EC 103 059-060 ; Document origianlly prepared at the now defunct Mass Center in Medford, Massachusetts

EDRS PRICE MF-$0.83 HC-$2.06 Plus Postage.
DESCRIPTORS Basic Skills; Elementary Secondary Education; *Individualized Instruction; *Instructional Design; Mentally Handicapped; *Programed Instruction; *Sequential Approach; *Severely Handicapped; Student Evaluation; Task Analysis; *Teaching Methods; *Trainable Mentally Handicapped

ABSTRACT

Presented are instructional development procedures for teaching pre-academic skills to severely/profoundly handicapped children in public school settings. Curriculum development and research is briefly reviewed and development of instructional sequences is detailed with discussions of the following topics: non-instructional intervention, instructional alternatives, developing instructional materials, task analysis, and learner analysis. The principles of programed instruction and programed tutoring are explained, the components of an instructional sequence are outlined, and instructional tactics (shaping, fading, modeling, and backchaining) are described. Also reported are numerous instructional sequence formats (including frame sequence and phase formats) which can be used to record task analysis based on instructional sequences so they can be quantitatively evaluated and replicated successfully. Finally, the topic of sequence monitoring/modification is addressed and it is concluded that although it requires considerable time and effort, the systematic development of instructional sequences can have many benefits for students and teachers. Appended is a list of questions to ask about instructional aides. (SBH)

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ED148033

TEACHING PRE-ACADEMIC SKILLS TO SEVERELY HANDICAPPED STUDENTS

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TEACHING PRE-ACADEMIC SKILLS TO SEVERELY HANDICAPPED STUDENTS

BY JAMES E. MCCORMACK

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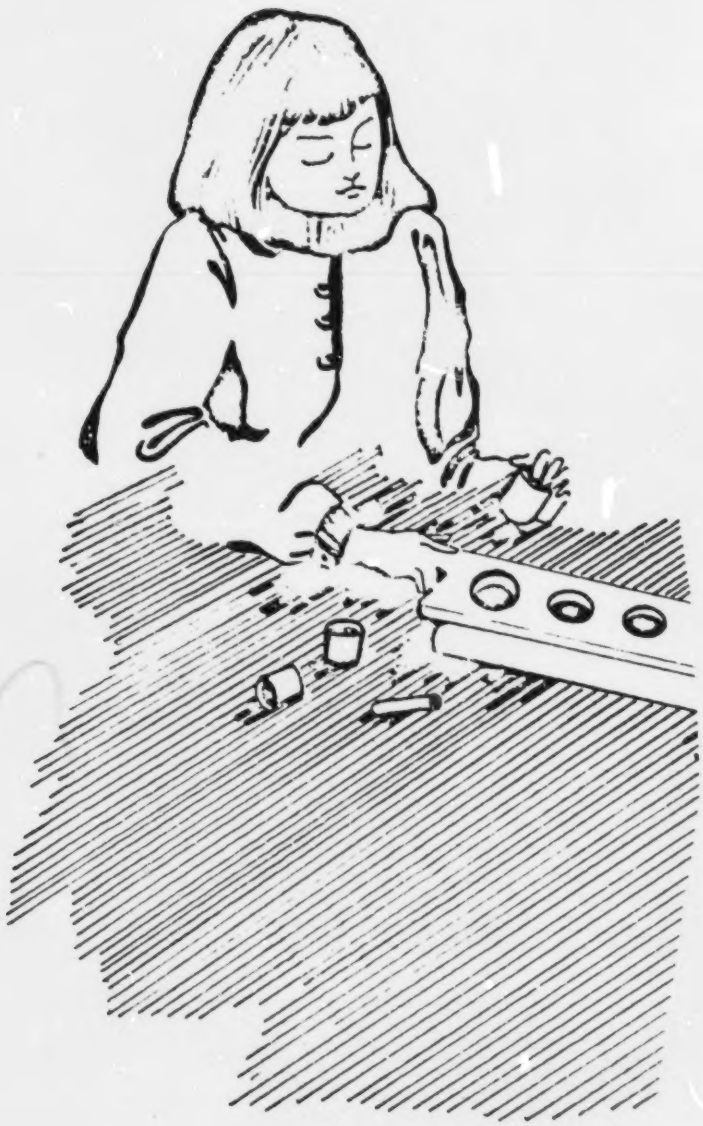

Introduction

Programming for the severely and profoundly handicapped in public school settings is quickly becoming more than an innovation. This is not to suggest that school administrators, boards of education, and/or special educators have responded to the needs of this population on their own initiative. It does, however, represent a response to the federal and state legislation which has resulted from the advocacy efforts of parents and professional groups. While the success of this movement is not assured nor is there uniform agreement on the school's role among professional and lay groups, there is evidence that public schools are moving forward in meeting legislative commitments to the severely and profoundly handicapped.

The establishment of programs for the severely and profoundly handicapped in the public schools does reflect a change in public policy and, hopefully, public attitudes toward the handicapped. Because this change did not occur as a result of an evolutionary process, there is no meaningful history to draw upon in developing specifications for public school programs. Certainly the experiences of institutions and day care programs offer a base for planning, but that base is totally insufficient when compared to the decision making required by public school personnel in program planning.

At the risk of over-simplifying the task of delineating areas needing development pertaining to programming for the severely/profoundly handicapped in public school settings, two general domains are proposed. Both are couched in the context of curriculum. The first pertains to the general area of curriculum development and curriculum research. The second encompasses an

array of programming concerns which represent instructional problems related to curriculum implementation. Although systematic curriculum implementation is essential if instruction is to continue to meet the student's needs, it is first necessary to develop the curriculum.

Curriculum Development/Research

Historically, the task of curriculum development was left to the special class teacher. It was not until the late 1960's or twenty years after the trend toward special classes began that curriculum development emerged as a priority. Before that, what was accomplished in curriculum development was carried out in SEA's and LEA's with insufficient funds and too frequently without the necessary expertise. Curriculum development is costly, time consuming and complex, but it is the basis for instruction. From an instructional perspective, Special Education should be synonymous with special curriculum.

Little has been achieved in curriculum development for severely handicapped students because it has only been recently accepted that they are capable of learning. What curriculum that did exist emphasized the development of motor and activities of daily living skills. Recently, program emphasis has changed, generally as a result of the potential benefits of vocational training, to include pre-academic, social and pre-vocational skills.

For the general population, pre-academic training addresses those skills which prepare the student to move to academic activities (cognitive skills). This training focuses on activities such as matching by attributes, identifying, constructing(puzzles,games),etc. Traditionally, given an extremely limited tradition, pre-academic skills for the severely handicapped have not led to pre-vocational skills.

Developing Instructional Sequences

Once appropriate developmentally rational instructional objectives have been identified, the teacher should begin considering the various ways in which each objective might be attained. Teachers often begin attempting to decide how to teach a skill without investigating the available non-instructional alternatives, e.g., environmental modification, prosthetic devices. Frequently, the manipulation of non-instructional alternatives will demonstrate that the student is capable of displaying the skill under supportive conditions and thus does not have to undergo extensive training if those supportive conditions can be made part of the student's usual environment. If non-instructional alternatives prove inappropriate, then the teacher must make a series of decisions involving the adopting, adapting or developing of an instructional material to teach the skill.

Non-Instructional Intervention: The teacher's initial responsibility when determining how to assist a student to acquire a target skill is to determine whether modifying the behavioral and/or physical environment will allow the student to display the skill. Non-instructional alternatives include the removal of physical obstacles (widening toilet stalls), the provision of assisting devices (hand bars), provision of prosthetic devices (dorsal feeding splints), or the modification of the inherent consequences of the environment (eliminating punishment, providing positive consequences, etc.).

Teachers should consider non-instructional alternatives in a specific sequence (Figure 1). The recommended sequence is based on the assumption that changing the physical environment is easier than changing behavior. Physical changes (widening doors, lowering sinks, adding ramps, etc.) in the environment do not involve the development of new behaviors from teachers, students, peers, etc. Prosthetic devices (i.e., dorsal feeding splints), although often requiring the student to undergo training in the use of this item, may allow the student to display the skill without having to undergo intensive and often unsuccessful training.

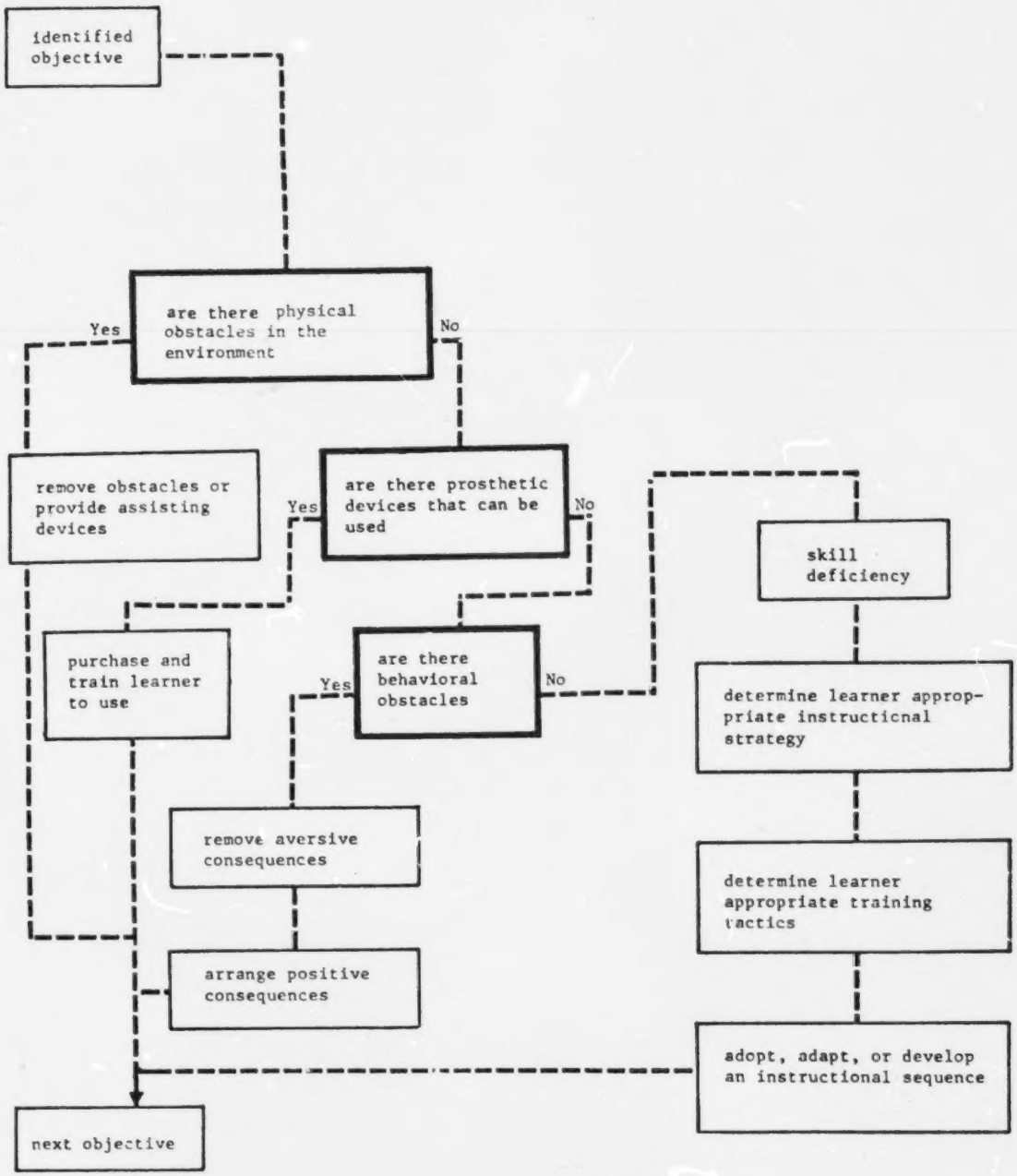

Figure 1. Alternative reactions to identified objectives.

The most difficult non-instructional alternatives to implement are those which require a change in the behavior of important individuals in the student's environment. The removal of behavioral obstacles to performance initially requires an assessment of the interactions between the student and important individuals in the environment. Through observation, the teacher should attempt to determine if there are any aversive consequences in the environment that are negatively affecting performance, if so, they should be eliminated. Observation should also reveal if any positive consequences (rewards) might encourage the student to perform the skill.

If none of the non-instructional alternatives appear to have any affect on performance, the teacher will have to assume that the skill does not exist in the student's behavior repertoire. Once the teacher determines that a skill deficiency exists, the next step is to initiate an evaluation of instructional alternatives.

Instructional Alternatives

Before a teacher can specify an appropriate instructional alternative, it is necessary to determine student-appropriate strategies and tactics. Instructional strategies relate to the selection of the general approach (e.g., behavioral modification, play centered, neo-traditional) to use when presenting the instruction. It is important that no instructional strategy be excluded from consideration only on the basis of a philosophical position for to do so artificially limits instructional options. Determining appropriate instructional tactics involves the various aspects of day to day implementation (e.g., process mode, reinforcement preferences, attention span).

Once strategy and tactics are determined through a learner analysis, the teacher must determine the most appropriate instructional procedure. There are three

broad alternatives available to the teacher who requires a specific instructional material: adopting an existing material, adapting an existing material, or developing a new material.

The simplest alternative is to find an existing material designed to develop the target for the skill which is also appropriate for the student. Unfortunately, the few materials designed specifically for moderately/severely handicapped students are usually difficult to locate. The diffusion of potential resources makes it frustrating and time consuming for the teacher to seek out information about instructional materials outside of his/her immediate location. Teachers frequently have to depend almost exclusively on their own ingenuity and industry to identify appropriate materials.

One alternative for materials identification is to use one or more of the existing commercial materials identification systems. The commercial systems generally provide in-depth information about existing commercial materials. A major drawback to the use of such systems is that they are usually too expensive to be purchased by an individual teacher. However, if the system is placed in a central location in the town and the teachers are trained in how to use the system, they can phone in their requirements and the resource person can use the system to identify the material. This works well if the teacher has a budget to purchase materials, if not, the teacher will have to wait until the material can be sent from the resource room.

The second instructional alternative, to adapt (modify) an existing material so it can be used with the learner, involves modifications such as color coding items, presenting materials in smaller steps, etc. Adapting materials depends primarily on the teacher's creative ability to see beyond the directions provided by the producer. Probably the most commonly used alternative adaption, however, is not

without its potential disadvantages (e.g., time consuming, permanent modification that will eliminate items from future use).

When selecting an existing material to be adopted or adapted, the teacher should consider the internal characteristics of the material (e.g., durability, directions, storage - see Appendix A for a complete list of questions). Once existing materials have been examined with regard to all factors, the teacher will have to decide if any of them can be adopted or adapted. If it is not possible to adopt or adapt an existing material, it will be necessary for the teacher to develop the required instructional material.

Developing Instructional Materials

The development of instructional materials is a difficult, time consuming process frequently required of those who work with moderately/severely handicapped students. Teacher developed materials are often imperative because of a lack of appropriate individualized instructional materials and the unique student needs. However, if materials development is approached in a systematic fashion, it is usually possible for the teacher to construct individually appropriate materials within an acceptable time frame.

When developing an instructional material, the teacher must consider many factors. There are many alternatives available when determining the appropriate strategies and tactics for the material. This document mainly describes a task analysis strategy to instructional sequence development, a learner analysis strategy to tactics selection and a programmed tutoring strategy to instruction. Taken together, these strategies answer the questions of what will be taught, in what order and how. These strategies typically are grouped together under the general title of behavior modification.

Task Analysis: Task analysis (Bateman 1967, Engelmann 1967) is the preliminary step in instructional development. It is the means by which the instructional task is broken down into component subtasks or phases (Semmel, Semmel & Thiagarajan 1974). Task analysis is the process of determining what to teach and in what sequence to insure skill acquisition. The sequence leads from responses present in the student's repertoire to those which comprise the target skill. In the case of psychomotor performance (e.g., building a five block tower), task analysis may be derived primarily from the observation of a skilled performer. With cognitive and social skills, the task analysis depends mainly on the teacher's ability to logically sequence the learning experience so that each subtask becomes the building block for the next and this continues until the target skill is being performed by the student.

A task analysis is only a component of the instructional material. It provides only the sequence in which subtasks will be presented. Equally important it allows the teacher to identify the essential prerequisite skills the student should have before beginning the sequence (Scandura 1966, Frank 1973). Due to the critical nature of the sequence in instructional development of the material, it is often referred to as the instructional sequence.

Learner Analysis: Based on the various information collected during the assessment process, the teacher should construct a statement of the student's learning style (including performance constraints). This should include information about the student, which if known, would enhance the student's attainment of objectives. Information, such as, recommended instructional strategies (behavior modification, play centered, etc.), tactics (reinforcement preferences, attention span, interest areas, etc.) and preferred receptive and expressive modes, is critical to the development of the instructional sequence. Any physical/medical constraints (includes effects of medication) should also be indicated when they have possible instructional ramifications.

Programmed Tutoring

When instructional sequence development is based on a basic task analysis approach, the results are often recorded as small discrete steps. These delineated steps make it possible to easily adapt the task analysis to a programmed instruction approach to teaching. The principles of programmed instruction formulated by Holland (1960) and derived from Skinner (1938, 1953) include:

* frequent student responses
* immediate feedback
* gradual progression to establish more complex behaviors
* control of the student's observing behavior
* cueing system to minimize errors
* gradual reduction of cues

Basically, programmed instruction consists of a series of combined teaching/testing tasks that are designed to carry the student gradually through the material to be learned.

Programmed instruction has been successfully used in various situations to assist handicapped students to acquire new skills (Bijou, Birnbrauer, Kidder & Tague 1966, Johnson 1967, Pfau 1969, Rainey & Kelly 1967, Wunderlick 1972). Espich & Williams (1977) provide a comprehensive guide to the development of programmed materials, while Schramm (1964) reviews considerable research on the effectiveness of programmed instruction.

Programmed tutoring (Ellson, Barber, & Harris 1968, Mayhall and Jenkins 1977) is an instructional technique based on programmed instruction (Skinner 1953, 1968, Stolurow 1960). Although programmed instruction is commonly associated with teaching machines (Pressey 1926, 1963, Skinner 1953) and programmed texts (Holland & Skinner 1961), Rummler (1970) suggests that it is a process involving systems and behavioral analysis, instructional design development and validation.

Programmed tutoring is a technique in which a human tutor (rather than a teaching machine or programmed text) presents the material to be acquired in a carefully ordered sequence. A unique aspect of programmed tutoring is the separation of the learning content from the tutoring operations. Subject matter is determined by a series of content lessons on frames. How it is to be taught is determined by an operational program which specifies the tutor's interaction with the student.

Components of an Instructional Sequence

An instructional sequence has numerous components. These components are usually divided into two sections: the order in which the task will be presented (determined through task analysis) and the tactics to be used to teach the task (determined from an understanding of the student's learning style). Each component must be carefully considered because even if only one component is ordered incorrectly, a significant delay in the student's progression through the sequence can result. In addition, if a component is too difficult or inappropriate to the student's learning style, the frustration that results can have long term effects on the performance. If skill acquisition is to be smooth and not unnecessarily difficult, the teacher must carefully manipulate each component during each step of the instructional sequence.

A systematically developed instructional sequence is organized in such a manner as to require the student to achieve a new level of competence in only one component at a time. Difficulties develop when the teacher is unaware of a component, thus does not consider it during sequence development. When this occurs, the student may be presented with a situation where two or more components are beyond current performance ability. It is this combining of unlearned levels that often prevents progress and results in a significant increase in incorrect responses and the side effects which accompany them.

Although the list of sequence components is potentially limitless, certain components are essential to every instructional sequence. These include eleven task analysis determined components and four learner determined components:

Task Analysis Determined Components

1. skill to be demonstrated: these skills, which can be displayed with various materials, are taken from the Objectives Matrix.

2. materials to be manipulated: for the learner to display a skill, one of these materials must be used.

3. cues or aids to be used: a cue is an aid that helps the student to make the correct response. By manipulating aids there are various ways to assist the learner to acquire skills. These aids can consist of such things as verbal instruction, samples of the completed product, color cues, etc.

4. learner receptive mode: how will the learner receive stimulus input? Alternatives include instructions or other stimulus materials presented through hearing, seeing, feeling, etc. Careful consideration must be given when presenting instruction that requires a combining of receptive modes.

5. learner expressive mode: how will the learner be required to respond? Although certain skills often are associated with a special expressive mode, there sometimes are expressive options within a skill, e.g., a learner can "identify" an objective verbally, graphically, or visually (sign).

6. material presentation sequence: generally only two sequences are used, the random sequence calls for a non-predictable presentation order within a session (xoxooxxoxox . . .), the fixed sequence involves a predictable presentation order within a session (xxxoooxxxooo . . .).

7. time limit on set or session: how long does the learner have to complete the task? The time limit is sometimes applied to each stimulus presentation (set) so that the teacher will know how long to wait before initiating the correction procedure. The session time limit is used when the learner has only to complete one task during the session (putting together a puzzle, completing a worksheet, etc.) and the objective is to speed up performance.

8. correction procedure: what should the teacher do if the learner makes an incorrect or no response? Alternatives include a) telling the learner part of the correct response and asking

him to complete the full correct response b) telling the learner the complete correct response and asking him to repeat the correct response c) the same procedure in a & b except a demonstration is used d) talk the learner through the correct response e) provide the learner with a correction key.

9. teacher present: during what percentage of the session is the teacher with the learner?

10. transfer situations: has the learner displayed the skill with various persons, in various locations and at various times of the day?

11. generalization: can the learner display the skill when similar yet different stimulus materials are used.

Student Determined Components

1. reward to be used: the reward used as part of the instruction can include almost anything, however, common items include food, drink, verbal praise, physical attention, toys, tokens, etc. Usually the shift should be toward rewards of general application, i.e. praise, tokens, etc.

2. reward priority: each learner has a specific hierarchy of preferred rewards. The priority should be considered when starting difficult tasks, when the learner is not progressing and when skill transfer is being attempted.

3. reward schedule: there are many schedules of reward presentation. Any basic text on behavior modification will present a complete explanation of each potential schedule.

4. reward quality: the amount of the reward is extremely important, especially with the saturation of food, drink rewards can be considered.

Within each component there are several alternatives that must be correctly ordered and appropriately manipulated. Figure 2 indicates some of the alternatives available within each component. In general, the progression through a component's alternatives involves moving a) from the concrete to the abstract, b) from gross discrimination to fine discrimination, c) from high cue dependence to no cue dependence, and d) from a static environment to a variable environment.

TASK ANALYSIS DETERMINED											STUDENT DETERMINED			
SKILL	MATERIAL	CUE	RECEPTIVE MODE	EXPRESSIVE MODE	PRESENTATION SEQUENCE	TIME LIMIT SET/SESSION	CORRECTION PROCEDURE	TEACHER PRESENT	TRANSFER	GENERALIZATION	REWARD	REWARD PRIORITY	REWARD SCHEDULE	REWARD QUANTITY
experience match sort construct point to name rote memory sequence use/apply associate classify analyze synthesize evaluate	motor 3D object picture color configuration size shape printed number printed letter printed word printed sent. other symbols spoken word spoken sent.	completed sample (FT) completed sample (PT) sequence position verbal command color shape combination of above	auditory tactile/ motor non-graphic visual visual sign combination of above	verbal tactile/ motor graphic non-graphic visual sign combination of above	fixed random	15 sec 30 sec 45 sec 1 min 5 min etc.	immediate tell/ ask tell/ask immediate demonstrate/ ask verbal key self-correction	100% 75% 50% 25% varies just at start not present	location tutor time	similar different	food drink tactile verbal material intrinsic etc.	1 2 3 4 5 6 etc.	fixed ratio variable ratio fixed interval variable interval random	1 piece 1 glass ½ piece ½ glass 5 sec. 10 sec.

Figure 2. Component alternatives.

Instructional Tactics

Figure 3 demonstrates how an instructional sequence can be developed through the systematic manipulation of component alternatives. The specification of exactly which component is being manipulated and how allows the teacher to detail explicitly what new skill the student is being required to perform. In the long run, this will allow the teacher to pinpoint those alternatives (skills) which assist the student as well as those which impede progress.

When determining how to assist students to acquire new skills, teachers have various strategies from which to select. Each of these strategies has its own tactics. Like other strategies the behavioral approach has specific tactics which are commonly associated with it. Some of the behavioral tactics commonly associated with skill acquisition are:

Shaping: Shaping literally refers to molding simple behavior into more complex behavior. Essential to the shaping process is the manipulation of reinforcement. Reinforcement must be administered systematically; that is, changing according to plan as the student moves through successive approximations of the desired behavior. Initially a reward is given when the student performs something already in his/her repertoire. Gradually, the student is expected to do more and more of the objective. For example, if the student is to perform the task of building a three block tower, initially reinforcement might be given when a block is touched. Later the student may be required to put one block on another before the same reinforcement is given. This gradual increase continues until the student is performing the entire task before being reinforced.

	SEQUENCE DETERMINED										LEARNER DETERMINED			
PHASE	SKILL	MATERIAL	CUE	LEARNER RECEPTIVE MODE	LEARNER EXPRESSIVE MODE	PRESENTATION SEQUENCE	TIME LIMIT SET/SESSION	CORRECTION PROCEDURE	TEACHER PRESENT	TRANSFER	REWARD	REWARD PRIORITY	REWARD SCHEDULE	REWARD QUANTITY
First	point	printed # 2,8	color 2(red) 8(black)	auditory/visual	motor	random	15 sec.	immed. tell/ask	100%	varied tutor/cubicle	candy	1	FR1	one piece
Second	↓	printed # 2,8,1	2(red) 8(black) 1(green)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
Third	↓	↓	2(red) 8(black) 1(green)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
...th	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
11th	↓	printed # 1-12	none	↓	↓	↓	↓	↓	↓	↓	↓	↓	FR2	↓
12th	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	FR5	↓
Last	point	printed # 1-12	none	auditory/visual	motor	random	15 sec.	immed. tell/ask	100%	varied tutor/cubicle	candy	1	FR10	one piece

Figure 3. Systematic manipulation of component alternatives

Fading: Fading is the gradual elimination of cues not commonly associated with the task until only the uncued task remains. When first learning a task, the student may require a great deal of assistance (physical and/or verbal cueing). As the student becomes more competent, this assistance may be reduced gradually. This gradual reduction of assistance is called fading. There are many forms of cueing, e.g. demonstration, sample, color cueing, position cueing. A sample fading sequence through levels of assistance might be:

1. total physical and verbal assistance
2. partial physical and verbal assistance
3. verbal assistance
4. gesture assistance
5. no assistance

If both physical and verbal assistance are being used, generally, fading of verbal assistance should be attempted after the physical assistance has been faded. For example, in teaching a student to build a three block tower, it may be necessary to provide physical and verbal assistance for each step, e.g., say, "put the block on the other block", and help the student to grasp and place the block. When the student begins to demonstrate some ability to perform the task, the teacher should probe to see if the student can perform with only the verbal cue ("put the block on the other block"). The fading of physical and verbal cues for each step continues until only the initial verbal command "build a three block tower" is required.

In most instructional sequences, fading is used in combination with shaping and vice versa. Together, the process explains how behavior modification techniques apply to behaviors that the child does not yet demonstrate. Since most classroom behaviors which teachers

might call academic involve adding new behaviors to the student's repertoire, the ability to use shaping and fading is critical to success.

Modeling: To learn a new task, it often is helpful for the student to watch a demonstration of the task being performed correctly. This procedure is called modeling (the student's behavior is called imitation) (Baer, et al. 1968). Initially, the demonstration is done slowly, in small steps, and accompanied by a verbal or signed explanation of the steps. Next, the model performs one step of the task at a time, giving the student a chance to repeat the behavior. If the student hesitates, physical guidance and verbal explanation should be given. For example, when building a three block tower, the model should demonstrate how to hold the block and then make sure the student is holding the block appropriately before moving to the next step.

Backchaining: When a student is taught a task by being required to learn the last step of a task analysis first, the next to last step second, etc., this procedure is called backchaining. Backchaining is used to maximize the probability of correct responses; thus it allows the teacher to constantly reinforce the student for successful completion of the task. Assistance (physical and/or verbal) is given on all the steps at first. For example, if the task is for the student to match blue, red, and green color cards, the teacher will physically assist the student to correctly place all the cards. Assistance is then given on every step except the last one (all the cards are matched except for the last one). The student, therefore, is required to complete only the last step independently. If the

student fails, the teacher resumes the total assistance procedure until the student is ready to try unassisted again. If the student is successful, the teacher rewards the student. As mastery of each step is reached, assistance continues to be withdrawn. Eventually, the student is expected to complete the entire task unassisted.

The teacher must determine the tactic most appropriate for the student and the task. A tactic that might be appropriate for one student may only have minimal success with another. Also,the tactic that a student required to improve rapidly may change as the student progresses toward the objective. Often,the same student may require different tactics with different objectives. Some objectives,due to their nature,have certain tactics that are more appropriate than any others.

What is an Instructional Sequence?

An instructional sequence is a written record of procedures to be used in a series of controlled teaching situations designed to assist the student in attaining a specific instructional objective (McCormack 1976). There are often hundreds of potential ways to achieve an objective and all are equally valid until empirical data indicates the superiority of some to others. However, before it is possible to evaluate an instructional sequence, it is necessary to record the sequence in a clear and complete manner. Instructional procedures often are written in a non-specific manner or not written at all; both situations make reliable evaluation impossible. Barrett (1965) suggests that until instructional conditions are described quantitatively, teaching will continue to suffer from the confusion of our limitless vocabularies.

Although the careful recording of instructional sequences initially is difficult and time consuming, the benefits of such a record go beyond facilitating learning

and instructional evaluation to include: a) other tutors can conduct the same sequence even during the teacher's absence, b) other teachers will be able to use the same sequence if it proves successful, and c) the teacher will be able to compare student performance to specific instructional input. Eventually, the teacher will have a library of sequences, especially if teachers pool their sequences, which will increase the probability that there will be an existing sequence which can be adopted or adapted to meet each student's needs.

Instructional Sequence Formats

There are numerous formats which can be used to record task analysis based instructional sequences so that they are able to be quantitatively evaluated and replicated if successful. No single approach is appropriate for all sequences. The exact format is determined by the form of task analysis and teaching tactics used. However, all the formats have the same general characteristics. Most importantly they present a careful sequencing of subtasks (frames, steps, phases) that allow the student to move from one level of functioning to another. At each subtask, the student is required to acquire a task slightly more difficult than the previous subtask (as seen from the starting level). This process continues until the student is able to perform the last subtask which is also the target skill.

Depending on the format, each new subtask will present some form of trial and error situation. To move from one subtask to the next means to move beyond a task of demonstrated competence to one of unknown difficulty where errors are possible. However, if the sequence is carefully constructed (the skill required of one subtask being only slightly more difficult than the previous), erroneous responses should be minimized. If student performance is monitored on a regular basis, the data will indicate whether the move from the previous subtask is

resulting in consistent errors and the teacher then can take remedial action. Allowing for the possibility of errors may cause some difficulty in the short run, but in the long run it represents a more normal learning/performance situation than do most of the more "errorless" approaches.

While the target skill selected may often appear simple to the teacher, the student may find it quite complex. There may be a substantial gap between where the student is functioning when instruction begins, and where the target skill is located (behaviorally speaking). If that gap, the distance between the past performance and the current task, is too great, the student may be forced to resort to ineffective guessing. Guessing can frequently be avoided by dividing the sequence into smaller, intermediate attainment subtasks.

Many procedures can be used to determine the subtasks of an instructional sequence, but they all involve some form of task analysis. For some tasks, especially self help skills, it is possible to determine the steps by observing and recording the sequential activities of a person performing the task. However, for most tasks the sequence is a functional representation of a teacher's conceptual orientation of the learning process. That is, the teacher decides what activities presented in what order will most assist the learner in acquiring the skill.

Instructional sequences are generally developed around these subtasks and are recorded either as a series of frames or phases. The frame approach, often referred to as the errorless approach, breaks instruction into the smallest sequential subtasks. This approach is similar to the programmed test used for a teaching machine, except that each frame is presented by the teacher. The phase approach breaks the sequence into larger steps by combining the material that would usually be contained in a number of frames. The phase approach is frequently more flexible than the frame approach and thus often more interesting for both student and teacher.

Frame Sequence

The frame (or errorless) format is used in the programmed instruction material utilized in teaching machines (Skinner 1968, Pressey 1926, 1963) and programmed texts (Holland & Skinner 1961). The frame approach presents each trial as a separate frame. Each frame is presented by the tutor in a manner similar to the way it would be presented by a teaching machine. Due to the minimal change in performance required from frame to frame, the student does not have to make the broad "jumps" from demonstrated ability into substantially unfamiliar areas which frequently lead to highly inefficient guessing behavior. Each frame consists of a small bit of information stated in such a way to assist the student to assimilate it readily and to respond to it easily and thus quickly proceed to the next frame. There is a gradual systematic progression from one frame to the next.

In writing a frame sequence the record generally consists of the material to be presented and the request (asking the student to do something with the material). The written sequence (Figure 4) should be augmented by a cover sheet which provides the following information:

1. instructional objectives
2. statement of need/relation to long term goals
3. prerequisite skills
4. material required
5. initial assessment procedure
6. reward/reward schedule
7. frame and sequence criteria
8. maintenance activities
9. presentation/correction procedures

To conduct a frame sequence, the teacher initially conducts the pre-test to determine the student's current ability with regard to the identified objective; in Figure 5, put the seven objects on the table and ask the student to point to each. If the student performs the task correctly, go on to the next objective. If the student errs in only a few of the items, the teacher might design a special sequence only using these erred items. If the student misses most or all of

INSTRUCTIONAL SEQUENCE RECORD

Sequence Name: Object Recognition **Draft #** 2

Author(s): James E. McCormack

Date of This Draft: December 1974

Suggested Session Frequency and Length: 3-5 **sessions per week.**
5-10 **minutes per session.**

Sequence Designed for: individual O, sm group O, class O Instruction.

1. Instructional objective: in a one-to-one tutorial situation the learner will be able to recognize (touch or point to) various objects (see materials section for list) on verbal command and without assistance.

2. Statement of need/relation to long term goals: this task continues the development of fine visual discrimination while also being one of the initial receptive language tasks. It helps develop prerequisite skills for more complex receptive language tasks.

3. Prerequisite skills:
   a) visual discrimination
   b) receptive language (one word)
   c) physically able to point or touch objects
   d) attention span of 5 to 10 minutes.

4. Materials required: shoe, glass, toothbrush, hat, dish, spoon, crayon - (actual objects).

5. Initial assessment procedure: conduct frames 16 to 22 as a pre-test. If the learner makes 6 or more correct responses move on to the next objective; otherwise begin the sequence at frame #1.

6. Reward/reward schedule: give a token immediately after each correct response and move on to the next frame.

7. Sequence criteria: the learner must respond correctly to frames 16 to 22 in order for two consecutive sessions.

8. Maintenance activities:
   a) include object recognition in group activities
   b) construct an object bingo game incorporating the objects and conduct during small group activities.
   c) conduct other recognition tasks using various other objects.

Figure 4. Frame sequence cover sheet.

9. Presentation/correction procedure:

   a) presentation--put indicated objects, randomly ordered, out on to the table and then ask the learner to "point to the _____." The learner is then to point or touch the named object. If the learner makes a correct response proceed to the next frame; if however, the learner makes an incorrect response, implement the correction procedure and move back to the previous frame. The session should be ended after a set time period or if the learner makes five consecutive incorrect responses. Whenever possible attempt to end the session with a correct response.

   b) correction--if the learner points to or touches the incorrect object, the teacher says "no", points to the correct object, has learner point to the correct object; the teacher then lets the learner hold the object while they talk about its use. The teacher then presents the previous frame.

Figure 4. (cont.) Frame sequence cover sheet.

INSTRUCTIONAL SEQUENCE RECORD

Sequence Name: Object Recognition **Draft #** 2

Author(s): James E. McCormack

Date of This Draft: December 1974

Frame #	Stimulus Materials	Request "Point to the ____ ."
1.	shoe	shoe
2.	shoe, glass	shoe
3.	shoe, glass	glass
4.	shoe, glass, toothbrush	shoe
5.	shoe, glass, toothbrush	toothbrush
6.	shoe, glass, toothbrush	glass
7.	shoe, glass, toothbrush, hat	shoe
8.	shoe, glass, toothbrush, hat	glass
9.	shoe, glass, toothbrush, hat	toothbrush
10.	shoe, glass, toothbrush, hat	hat
11.	shoe, glass, toothbrush, hat, dish	shoe
12.	shoe, glass, toothbrush, hat, dish	glass
13.	shoe, glass, toothbrush, hat, dish	toothbrush
14.	shoe, glass, toothbrush, hat, dish	hat
15.	shoe, glass, toothbrush, hat, dish	dish
16.	shoe, glass, toothbrush, hat, dish, spoon, crayon	shoe
17.	shoe, glass, toothbrush, hat, dish, spoon, crayon	glass
18.	shoe, glass, toothbrush, hat, dish, spoon, crayon	toothbrush
19.	shoe, glass, toothbrush, hat, dish, spoon, crayon	hat
20.	shoe, glass, toothbrush, hat, dish, spoon, crayon	dish
21.	shoe, glass, toothbrush, hat, dish, spoon, crayon	spoon
22.	shoe, glass, toothbrush, hat, dish, spoon, crayon	crayon

Figure 5. Frame sequence record.

the items, the teacher should start with Step #1.

To implement the training program, begin by doing what is required in frame #1. If the student makes an incorrect response, the teacher implements the correction procedure and repeats the frame. If the student makes a correct response, the teacher reinforces the student and moves to frame #2. Generally, after frame #1, when the student errs the teacher will implement the correction procedure and go back to the previous frame. The length of a session may be determined by the number of trials per session, length of the session etc. Generally, the session should end with a correct response.

Modified Frame Format: A modified frame format (Figure 6) is used when cueing or response requirements change from frame to frame. In the sample sequence both of these elements are systematically manipulated. The procedure is intended to use a previously acquired skill (i.e., pointing) as part of the sequence to develop a new skill (naming); therefore, being able to recognize by pointing is a prerequisite for this sequence.

Phase Format

An alternative to frame format is the phase format. The phase format breaks the sequences into larger steps by combining the tasks that would be contained in a number of frames. For example, the material combined in Frames 1-6 in Figure 7 might be presented as one phase. All the material in a specific phase would be presented during the same session.

Although some target skills may be obtained in a single phase, many others may be more effectively obtained through a series of phases, i.e., teaching lette naming with 3 letters at a time (per step) instead of starting with all 26. The determination of how many steps are necessary, when the sequence is for a single

SEQUENCE: naming numbers AUTHOR: J.E. McCormack DATA: April 1975

Frame	material presented		cue and/or request
1.	[1]		This is 1(point). Point to 1
2.		[1]	Point to 1
3.	[1]		This is 1. What is this?
4.	[1]		This is (initial sound). What is this?
5.	[1]		What is this?
6.		[5]	This is 5(point). Point to 5.
7.	[5]		Point to 5
8.	[5]	[1]	Point to 5
9.	[5]		This is 5. What is this?
10.	[1]		This is 1. What is this?
11.	[1]		This is (initial sound). What is this?
12.	[5]		This is (initial sound). What is this?
13.	[1]		What is this?
14.	[5]		What is this

Figure 6. Modified frame format.

learner, is based on the task's complexity and the student's current capabilities. However, the method recommended when working with a group of students who are attempting to acquire the same target skill but functioning at different competence levels is to construct the instructional sequence for those students demonstrating the least competence, i.e., analyze the task into the simplest phases. When using such a sequence, the more capable students may simply skip steps.

The phase format is less mechanical than the frame format because it usually allows the teacher to structure the sequence in which the material will be presented during a specific session. Also, a wider range of stimulus materials will be used during a session. Although errors are more common with the phase format, significant difficulty can be avoided if performance is monitored and modifications made if the error rate is consistently high.

Recording the Components of a Phase Sequence: Once the teacher has developed a sequence, it is necessary to record it in such a manner that it can be implemented/replicated by others. To avoid an unwieldly record it is necessary to combine components. Most of the information required can be provided by answering the following seven questions:

1. What materials are necessary? Indicate and describe what instructional materials are required to conduct each phase.

    - five colored picture cards: dog, tree, glass, spoon, car.
    - letters A (red), K (blue), O (green), each on separate 2 x 2" white cards (2 sets)
    - days MONDAY (blue), TUESDAY (blue), FRIDAY (red) each on separate 2 x 6" white cards.

2. How are the materials arranged? How should the tutor arrange the materials on the table, blackboard, etc., (sometimes a small diagram is helpful).

PHASE	MATERIALS	WHAT YOU DO WITH THE MATERIALS	WHAT YOU DO AND SAY	WHAT THE LEARNER DOES	PRESENT EACH STIMULI	TOTAL TRIALS	WHAT YOU DO IF HE DOES IT *RIGHT*	WHAT YOU DO IF HE DOES IT *WRONG*
Pre-Test	Conduct Phase 8 as a Pre-test:							
1	color cued shapes; 3 of each: circle (orange), star (blue), square (red), triangle (black)	△□○☆ △○□☆○□☆△	"sort and match the shapes"	sort shapes into appropriate piles	twice	16	token and praise after each correct response	correct immediately and explain
2	As Above	△☆□ □△□○☆○△☆○	"sort the shapes"	As Above	twice	18	As Above	As Above
3	As Above	△☆ ☆○□△☆□○△○□	As Above	As Above	once	10	As Above	As Above
4	As Above	△ □○☆□△☆○□△○☆	As Above	As Above	once	11	As Above	As Above
5	As Above	△○□☆□○△☆☆○△□	As Above	As Above	once	12	As Above	As Above
6	3 of each; star (blue), triangle (black), circle & square (orange)	□△○□☆☆△□○☆□○	As Above	As Above	once	12	As Above	As Above
7	3 of each; star circle & 9 square (orange), triangle (black)	□○☆△△☆○□○□△☆	As Above	As Above	once	12	As Above	As Above
8	3 of each; star circle, square and triangle (all orange)	☆○□△□△☆☆△○○□	As Above	As Above	once	12	As Above	As Above

FIGURE 7.

Instructional sequence record sheet

- spread one set horizontally and give other set to learner.
- place letter desired and one distractor on table for each trial.
- hold up to learner one at a time.

3. What does the tutor do and say? Indicate the procedure by which the tutor will present the materials and the task to the learner.

   - "match the picture"
   - "This is the letter __." Teacher points to letter then removes hand. "Point to __."
   - Teacher holds up card. "What does this say?"

4. What is the correct response (CR)? What should the tutor expect the learner to do as a result of the presentation of materials and instructions.

   - place each picture in the hand held set on matching picture on table.
   - point to the letter named.
   - read the day card.

5. How many trials per session? How often will each stimulus situation be presented in a session. Also indicate total number of scored responses.

   - two repetitions (randomize the sets for each repetition). Ten scored responses.
   - present each letter four times in random order. Twelve scored responses.
   - present each card five times in random order. Fifteen scored responses.

6. What if the learner makes the correct responses? What does the tutor do if the learner does what is desired? Indicate the type of reward and schedule to be used.

   - give peanut and praise after each correct response.
   - give token and praise after each CR.
   - give praise after each CR; token after each two CR's.

7. What if the learner makes a mistake? What does the tutor do if the learner makes an incorrect response ($\overline{CR}$)?

   - immediately after $\overline{CR}$, show learner CR and explain.

   - "No, this is __." (Tutor point to CR). Assist if necessary. Give praise. ("Can you point to __.")

   - "This is __." "On __ we go to the (pool, gym, etc.). Now, what day is this?" Give praise for CR.

These seven questions can be organized into a simple recording format.

Figure 7 shows what an instructional sequence looks like when put into such a recording format.

Constructing a Sequence Cover Sheet: Once the instructional sequence has been completed, teachers may find it helpful to construct a cover sheet that will assist others in determining if the sequence is appropriate and/or usable for meeting their needs. This cover sheet should include the following information:

1. Instructional objective: Instructional objectives should be stated in the format that specifies that exact target behavior.

2. Statement of the need: To what general skill cluster (or goal) is this objective related? What learner needs will the attainment of this objective meet? Once the learner attains this objective, what is the next instructional objective(s)?

3. Prerequisite skills: What prerequisite (or entry) skills or competencies should the learner possess in order to begin this sequence in the most expeditious manner?

4. Materials required: What instructional materials are required to complete this sequence? If the materials are commercially available, indicate the name of material, catalog name and page number. If the materials are teacher-made, detail the characteristics (size, color, shape, etc.) of each item.

5. Means of initial assessment: How well can the learner initially perform the skill indicated by the instructional objective? This initial assessment is generally determined by the type of skill to be measured. Two common procedures are: a) baseline, observing and recording the learner's performance of this objective's terminal skill in a natural environment, i.e., the number of times the learner interacts appropriately with classroom peers, b) pre-test, a procedure which provides a structured situation in which the learner is required to perform the objective skill to determine current level of functioning; i.e., if the objective is to recognize the alphabet letters then the learner should be asked to perform the task.

6. Reward/reward schedule: If this instructional sequence is constructed for a specific learner, then it is possible to indicate the precise rewards and schedule to be used. However, if the sequence is for a group of potential users, it may only be possible t outline general considerations regarding the use of rewards.

INSTRUCTIONAL SEQUENCE COVER SHEET

Sequence Name: Shape Sorting *Draft #* 2

Author(s): James E. McCormack

Date of this Draft: December 1974

Suggested Session Frequency and Length: 4-5 *sessions per week*
5-10 *minutes per session*

Sequence Designed for: Individual☒, small groups ☐, class ☐ Instruction.

1. *Instructional Objective:* in a one-to-one instructional situation the learner will be able to physically sort cardboard shapes (triangle, star, circle, square) into appropriate piles upon verbal request and without assistance (see #7 for success criteria).

2. *Statement of need/relation to long term goals:* this pre-academic sequence relates to the development of visual discrimination and hand/eye coordination skills. In addition it provides the basis for the development of various pre-vocational and vocational skills.

3. *Prerequisite skills:* can match cardboard shapes and can maintain attention for five to ten minutes.

4. *Materials required:* various cardboard cutout shapes; each approximately 3" × 3".
   star: 3 blue and 3 orange
   triangle: 3 black and 3 orange
   square: 3 red and 3 orange
   circle: 3 orange

5. *Means of initial assessment:* conduct Phase 8 as a pre-test.

6. *Reward/reward schedule:* this sequence is designed to use token or social reinforcement; however other forms of reinforcement can be used and in such cases should be indicated in the Sequence Record column, "What You Do If He Does It *Right*".

7. *Sequence and phase criteria:* sequence criteria—90% or better correct for 3 consecutive sessions completed in less than 4 minutes. Phase criteria—90% or better for 2 consecutive sessions completed in less than 5 minutes.

8. *Maintenance activities:* include task in group activities and other sorting tasks that require more detailed discriminations.

FIGURE 8.

Instructional sequence cover sheet

7. Sequence and phase criteria: The criteria for completing the sequence should be indicated in the instructional objective statement. Criteria for phase change should be listed to provide the teacher with the information necessary to know when to move the learner to the next phase/step/frame. Criteria may be indicated by frequency, percentage, rate of correct response or in various other ways.

8. Maintenance activities: What activities should be implemented once the learner completes this instructional sequence to allow the learner to practice and thus maintain the skill. Although frequently the skill will be maintained through its inclusion in the next objective, it is also beneficial to conduct various generalization and transfer activities. For example, an individually acquired skill might be included in small group or whole class activities.

To simplify the process, the eight areas can be arranged into a format which allows the teacher to record the necessary information. Figure 8 shows how information can be recorded on this cover sheet.

Sequence Monitoring/Modification

Once the sequence is implemented the teacher should constantly monitor performance to determine if the student is making acceptable progress. If the student is progressing rapidly, the teacher may attempt a probe, skip the instruction ahead a dozen frames or a few phases. If the student is progressing slowly but at an acceptable rate, probably no modification is necessary. If a review of performance data indicates the student is not progressing, the teacher will have to modify instruction. There are many possible alternatives, the one commonly used as an immediate action is to move the student back a dozen frames or one phase. If this is unsuccessful in assisting the student when returning to the problem phase/frames, it usually is necessary to begin a detailed error analysis to determine exactly what components have to be changed.

The accumulation of systematically recorded data on a specific instructional sequence over a number of students will allow for the empirical analysis of the various component characteristics of the sequence. The success or failure of

learners on the same sequence provides a major element required in the functional assessment of component characteristics. This information should make it possible to answer numerous teacher questions about their instructional sequences. Questions such as:

* are phases which appear to present little difficulty too redundant or oversimplified
* are there sequence phases that could be changed to make greater demands on the learner without sacrificing overall acquisition
* are there sequence phases that could be dropped completely without endangering learner momentum
* are there gaps where completely new phases should be constructed

By focusing attention on those sequence phases which present unusual difficulties for the greatest number of students and those which are relatively simple for the same students, it should be possible for teachers to identify those component characteristics that sort students into different acquisition groups. Once those characteristics are identified, it should be possible to construct phase modifications to avoid or to provide additional assistance with difficult characteristics. Students' behavior change, or lack thereof, will indicate whether or not the modification was successful. The successful modification will serve as a tool for "trouble shooting" other sequence phases with similar component characteristics.

Conclusion

The instructional development procedures presented have concentrated on a task analysis approach to individualized instruction. Although group activities are essential to social skill development, experience has indicated that it often is necessary initially to establish a skill through individualized instruction, and then to introduce it in group situations; this is recommended because the simultaneous development of performance skills and social skills often overwhelms the severely handicapped learner.

The development of individual instructional sequences is only a segment in the comprehensive education of severely handicapped learners. It's an important segment, and it requires considerable effort in order to attain maximum benefit. Considerable time must be expended to develop support elements, such as, classroom organization, data collection and monitoring, volunteer training, parent training, small group activities, etc.

Although it requires considerable amounts of time and effort, the systematic development of instructional sequences can have numerous benefits for students. and teachers. Viable instructional sequences that can be implemented by almost any professional, para-professional or volunteers open the class to many individuals who previously have had little contact with the severely handicapped. Thus, besides helping students to acquire skills, the skills needed to live in our society, the procedure also increases the probability that "normals" will give them the chance to use those skills.

Appendix

QUESTIONS TO ASK ABOUT INSTRUCTIONAL AIDES

1. Are instructional objectives stated?
2. Are the prerequisite skills required of the learner to effectively use the material stated?
3. Are the prerequisite skills required of the teacher to effectively use the material stated?
4. Is the presentation mode appropriate for the learner?
5. Does the instruction follow a logical sequence?
6. Are the directions complete and accurate?
7. Is the teaching strategy clearly and completely indicated?
8. Are storage and/or retrieval requirements prohibitive?
9. Will preparation time prevent regular use?
10. Is the answer key (if provided) useful or can one easily be constructed?
11. What student/teacher ratio is necessary to use the material?
12. Is the material capable of maintaining instructor interest?
13. Is the procedure for detecting errors and making corrections sufficient?
14. Is the stated mastery level (criteria for success) indicated?
15. Are there alternative approaches to using the material to attain the same objective?
16. Is the material capable of maintaining student interest?
17. Is the material durable?
18. Is the teacher's guide (if one is provided) complete?
19. How often will it be necessary and how difficult will it be to replace consumable parts of the material?
20. What are the strengths and weaknesses of the validation information provided?
21. What is the cost/price/value estimate?
22. Are the material's technical aspects, i.e., size of print, quality of pictures, etc., acceptable?

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